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EUGENICS LECTURE SERIES. XIII

SIDE LIGHTS ON THE EVOLUTION OF MAN

BEING A LECTURE DELIVERED AT THE ROYAL INSTITUTION, FRIDAY, MAY 14, 1920

BY

KARL PEARSON, F.R.S.

WITH SEVEN PLATES AND TEN DIAGRAMS IN TEXT

CAMBRIDGE UNIVERSITY PRESS
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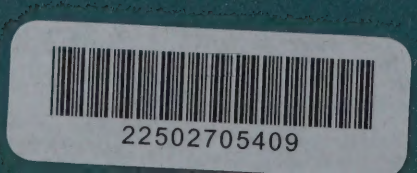
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In order to modify effectively Man's Future it is above all needful to understand his Past. For, without such understanding we cannot appreciate the degree in which the sources of his conduct are the outcome of current racial traditions, of present education and of existing economic forces, or on the other hand are survivals of an inbred temperament produced by past stages of evolution but in our present environment not yet wholly obliterated. In short, without this understanding we shall not learn the extent to which we can build Man's Future by merely modifying Man's faulty Nurture, or whether our only hope of permanent progress really lies in eliminating by selection the crudities of Man's Nature.

SIDE LIGHTS ON THE EVOLUTION OF MAN

It is somewhat venturesome for a biometrician to roam into the field of evolution; for, however much the biologists differ among themselves, they are agreed on one point: that no stranger ought to trespass into their preserves. Again, the intruder is still less justified in his proceedings, if he frankly admits that he intends to be hopelessly one-sided in his material and therefore in the side lights which it can throw on the evolution of man. Tonight I propose to confine my attention to one bone of the skeleton only, the femur or thigh-bone, and to ask whether it can possibly throw any light on the evolution of man. This mode of attacking the fundamental problem of man's origin is not really so narrow as it may at first sight appear. The intensive study of a single bone may really lead us further than wider comparisons which do not go as deeply into individual characteristics. Indeed the basis of most modern work on the pedigree of the primates is already tinged by this fault, if a fault it can be called. Pedigrees have been built up by studying the skull, or even the teeth alone, or by placing reliance on the evolution of a single organ. The study upon which the present view is based was commenced in 1903 and not finished till its final publication in a monograph by Dr J. Bell and myself issued in the present year. I fear, however, that we cannot claim value for our results merely by the time and energy spent on their deduction. We must wait and see how far concurrent work on other organs is or is not leading in the same direction.

Our knowledge of the origin of man has advanced enormously in the last twenty years, not so much by cautious scientific enquiry as by almost fortuitous discoveries. In anthropology we have had many plodding workers, but no epochmaker. There has been no Einstein, no single genius, who, even in the years of a great war, could force a revolution in physical, nay in philosophical and theological thought, on the world. And yet a single chance discovery may do this for anthropology at any moment! What we may labour years to reconstruct from the faint suggestions written in the organs of existing living forms may be found at any moment; the discovery of a single fossil bone

might suffice to indicate how man had diverged from lower primate forms. Judging by the rate at which primate fossil forms have been found in the last few years, it is almost impossible to believe that such a progress can continue for another ten years without a discovery which shall reveal to us the nature of our ape-like ancestor—the prot-simio-human—that is, the first ape-like man, or, if you prefer it, the first man-like ape.

Now I am inclined to think that if we could get back to that prot-simio-human either by reconstruction from vestiges—debris I should almost call them of our past history—or by the actual discovery of fossil remains, we should be surprised to find that our prot-simio-human was in many characters as human as it was ape-like. In other words man is in many respects primitive, and it is the ape of today that has evolved and found it advantageous to throw off some of the more primitive characteristics. I do not think that any of the anthropoids have remained stationary, any more than man has remained stationary. The proper attitude is surely not one of belief that man is descended from an anthropoid—we might as well assume that the modern anthropoid had descended from a man. I think that the correct statement will be found to be that the prot-simio-human was much more ape-like than modern man, and considerably more man-like than the modern anthropoids. The problem that lies before us is this: The anthropoids have diverged, no doubt widely, from the prot-simio-human, but have we any evidence to indicate that one rather than another of the recent anthropoids has retained more of what we believe from vestiges in the man-anthropoid group of primates to be prot-simio-human features?

I am aware that a distinguished anatomist has quite recently asserted that we must go in our pedigree behind *Tarsius* before we can link man ancestrally with the anthropoids. He would thrust out of account not only the anthropoids, but the Old World monkeys and the lemurs and apparently assert that the nearest primate to man is *Tarsius*: see Pl. I, 1. The difficulty of this view is two-fold. In the first place it leaves us with a tremendous gap to cross of which *not one single* step is represented by either a fossil form, or by a reconstructed form which we can suppose to be a branch point of another primate. To suppose *Tarsius* the nearest known ancestor of man is to say practically that we know nothing at present of the evolution of man.

And secondly, if we confine our attention to the topic of our lecture tonight, namely, the thigh-bone, we should have to insert in the evolution of the femur from *Tarsius* to *Homo* a number of stages which would

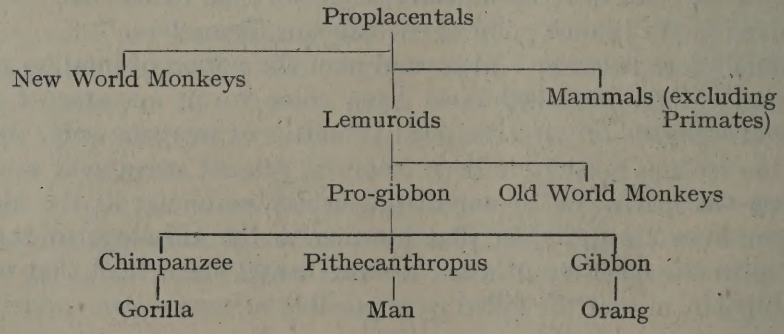
introduce characters of the femur possessed not by man only but by other primates from baboon to chimpanzee. It may be quite true that characters may have been acquired twice, or even several times, in the course of evolution, but this is exceptional in closely related living forms; and Occam's Razor may be extended to biological reasoning, and without grave cause we ought not to assume like characters, especially if they are vestigial in their nature, to have arisen without ancestral linkage. Anyhow the femur teaches us that we should want stages in the development of the human thigh-bone from *Tarsius* to man, which have extraordinary resemblance to branch points which are needful in the ancestral history of the remaining primates. In other words if the remaining primates did not branch off from man's ancestral history more recently than *Tarsius*, we should be compelled to insert stages which closely resembled such branch points, and further to assume that all such stages had disappeared as fossils and left no lines descending to modern times. To those who loathe the notion of descent from the raw and violent, there may be something soothing in the hypothesis that man has descended without raw and violent stages from the innocuous, if quaint, little *Tarsius* or from Tarsidian forms. The distinguished anatomist to whom I have referred, apparently considers that Haeckel and Huxley by emphasising an ape-like human ancestry have led to all the misery of the past five years. He forgets that human rawness and human violence existed thousands of years before the Darwinian teaching, and are *pro tanto* evidence of a raw and violent ancestry for man. There must have been a raw and violent stage in man's development, and if it was not ape-like, what was it? Man did not reach machine guns and bombs without having used swords and battle-axes, and he did not reach swords and battle-axes without an earlier use of sticks and stones. *Tarsius* may not know that sticks and stones are good for offence and defence, but somewhere that notion of profiting by violence must have come to an ancestor of man, and that ancestor, both psychologically and muscularly, must have been nearer a baboon than to *Tarsius*, if indeed he were not the branch point of the baboons themselves.

Somewhere between *Tarsius* and man the notion of hunting to the kill and eating the killed must have come to an ancestor of man; without weapons or with the most primitive of weapons only, the kill and the feeding must have been from our present standpoint raw and violent—as loathsome to our distinguished anatomist as the idea of descent from an ape. Yet that hunting to the kill stage must have existed in the ancestry of man; a more brutal stage than that of the anthropoids, in that the killed were possibly of man's own species. At

that branch point of his upward career man was certainly not a gorilla, but he must have been nearer physically and psychically to the gorilla than to *Tarsius*. Build up as close a relationship as you please between *Tarsius* (or a tree-shrew) and man in the extreme distance, you will find an immediate past which is physically and mentally troglodyte, heavy in build and violent in character. Man of palaeolithic times was not agile in motion, slender in his proportions, gracile in his bones, or dexterous in his flight from possible foes. He won his way as a violent fighter and a ravenous feeder, not as a gentle, shy, and fugitive animal. He was not gibbon-like or hylobatic in character. We owe more than half our troubles today to this ancestry, and we shall not free ourselves from this taint by simply asserting that the hypothesis of a troglodyte ancestry for man is a "stain on British science." It is either true or false, and our problem tonight is, what light does the thigh-bone throw on what after all is the basal problem of mankind? Is the brutality and violence of man today a fall from a higher estate, or an atavism, a relic of a violent past? A sign of a degenerate modern civilisation or a vestige of an ancestral barbarism? The problem, strange as it may seem, is socially a very vital one; in the first case the remedy lies in a changed training and a changed environment; in the second case we can only hope to breed it out. It is the world old alternative between nature and nurture, which crops up, even in such a seemingly remote problem as that of whether the prot-simio-human was troglodytic or hylobatic in his thigh-bone. For the single bone determines the correlated structure, and the structure determines the mentality and the habits. Was the prot-simio-human a combatant or a non-combatant, a fighter by nature, or a conscientious-objector of his day?—That is, I take it, the kernel of the matter.

Now let us go back to one of the earliest post-Darwin pedigree makers, Ernst Haeckel. In his *Last Words on Evolution* of 1905 he gives the pedigree I first exhibit:

Haeckel's Pedigree of Man.



Now I have no objection to something not a lemuroid but of the nature of a lemuroid being a branch point in the ancestry of man. There are anomalies in the femur of man which seem undoubtedly vestiges of a lemuroid ancestor. Such for example are the "lateral protrusion of the anterior face" and the "frontal pilaster" which occasionally occur in man. I show these in first a human femur alongside lemurs, lion and kangaroo (Pl. I, 5), and then in a Peruvian femur first pictured by Rodriguez (Pl. I, 2). It is very marked in a Fuegian femur figured by Martin, of which Professor Schaffhausen has most courteously sent me a cast (Pl. I, 3). But "lateral protrusion" in a less marked form (Pl. I, 4) is by no means very uncommon in Recent Man as evidenced in the following table.

Now examining this series:

Recent Man (101)	33 %
Negroes (48)	65
Berbers and Guanches (82)	80
Neolithic Man (151)	86
Palaeolithic Man	Almost invariable
Lemuroids	Invariable

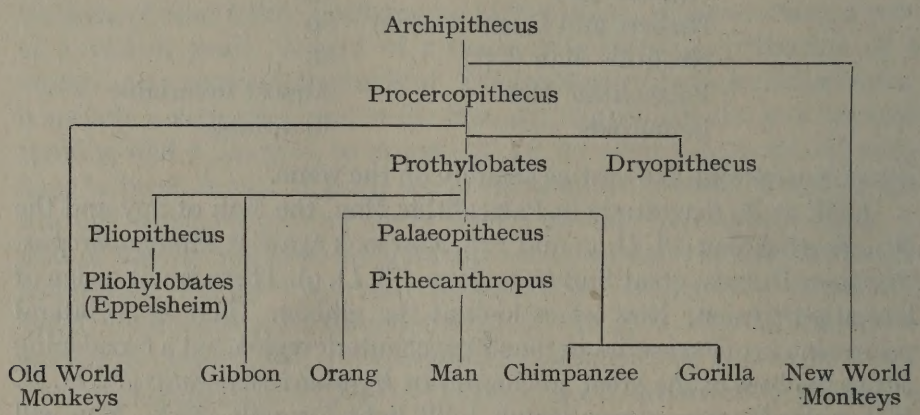
we see a lemuroid-like vestige steadily on the wane.

Look at its magnitude in Palaeolithic Man, the Man of Spy and the Neanderthal Man (Pl. II, 11 and 12). Now look again at *Pithecanthropus*, Professor Dubois' great find from Java (Pl. II, 9). There is not a sign of lateral protrusion. Now let us look at the gibbon. There is no lateral protrusion in our sense, i.e. in the subtrochanteric region, but a broadening out to the base of the great trochanter in *Hylobates variegatus* (Pl. II, 7). It is a slender non-rugous femur, built light for agile work. You will grasp it better still in the next illustration (Pl. II, 8). Here we have in the centre the fossil gibbon *Dryopithecus rhenanus* from Eppelsheim, and young and old thigh-bones of recent gibbons (*Hylobates mülleri*). You see that even with this great fossil gibbon the lateral protrusion has already disappeared, but while still in all its indices hylobatic, *Dryopithecus rhenanus* is more robust than the recent gibbons, which have grown more slender than their ancestral form. In other words, as we go back towards our prot-simio-human the femur, even of the gibbon, tends to greater robustness. Now return for a moment to Haeckel's pedigree. If we accept, with Haeckel and Dubois, that the Trinil femur is that of an ancestor of man, we are bound to place, as Schwalbe did, Neanderthal Man or his branch point between

Pithecanthropus and Recent Man. The result of this is that we find in the line of descent: Tree-shrews or lemuroids with lateral protrusions, then gibbons and pro-gibbons practically without it and in the human line also *Pithecanthropus*. Next, it reappears again in the greater anthropoids and in Palaeolithic Man, and it largely disappears except as an anomaly in Recent Man, while indications of it remain in neolithic and primitive Modern Man!

Again I must point out that while several of the *Simiadae* or Old World monkeys, especially the baboons, have deeply fossed and rugous thigh-bones akin to those of the chimpanzee and man (Pl. IV, 22), Haeckel's pedigree differentiates them off from the greater anthropoids and man by a gibbon-like form. In other words, it again involves us in a whole series of re-creations or re-originations of like features.

Dubois' Pedigree of Man.



The same sort of criticism applies to Dubois' pedigree of man. The ancestor of the *Cercopithecidae* must have had a robust and bowed femur. In a still more marked manner this must have been a feature of the common ancestor of chimpanzee, gorilla and orang. Yet here is a pedigree interpolating, straight, slender and gracile thigh-bones, between massive, bowed and rugous stages.

The markedly bowed forms of the Mousterian human type (Pl. III, 13–15) must be developed afresh from the scarcely bowed hylobatic forms, although in *Procercopithecus* they were almost certainly present, for they exist in the *Simiadae*.

These difficulties of interpolation of the gibbon-like stages into the ancestry of man are accompanied by others of a still more striking kind.

I must remind you that the find of *Pithecanthropus* at Trinil (Pl. II, 9) consisted of three fragments discovered at some distance from each other: (i) a skull-cap, (ii) a molar, and (iii) a femur. There is not a single feature in this Trinil thigh-bone which is not "Recent Man." It is bowed, it is "pilastered," it has the usual proportions of the femur of modern man. (To bring home to the reader the nature of the pilaster, I give exaggerated cases in Pl. IV, 19–21.) I cannot believe that had the Trinil femur alone been discovered together with a hundred thigh-bones of modern man, it would ever have been recorded as anything else but a human femur. Dubois himself, in the latest contribution he has made to the discussion, still seems able to raise no argument for the ape-like in the femur beyond the convexity of the popliteal area. The section for testing this we take at 1/20 the length of the shaft, which in man is about 4 cms. above the condyles. Here are popliteal transverse sections in the anthropoids and primogenial man (Pl. III, 17 and 18). With the possible exception of the orang the surface is convex. In Neanderthal Man it is also convex; it becomes almost flat in Cromagnon Man, and Galley Hill Man (or better Woman!) is a good intermediate between Hauser's Mousterian Man and Recent Man. (See also Pl. IV, 23 and VI, 35.) The infant gorilla and infant chimpanzee show the slightest tendency to concavity which does not appear in their later stages.

Is this—nearly the only argument for the antiquity of form of the Trinil femur—a valid one? I think not. Here is a figure (Pl. III, 16) showing the usual concave sections of Recent Man and one showing the convex sections which may easily be met with. We examined the nature of the curvature in 800 English femora, and we found the following results:

Curvature Percentages of Popliteal Surface in 800 *Human Thigh-bones.*

	Convex	Flat	Concave
Male right	51·5 %	13·5 %	35·0 %
Male left	49·0	24·0	27·0
Female right	32·0	16·0	52·0
Female left	34·5	22·0	43·5

These show that in the male convexity is actually more frequent than concavity, but the proportions are reversed in the female.

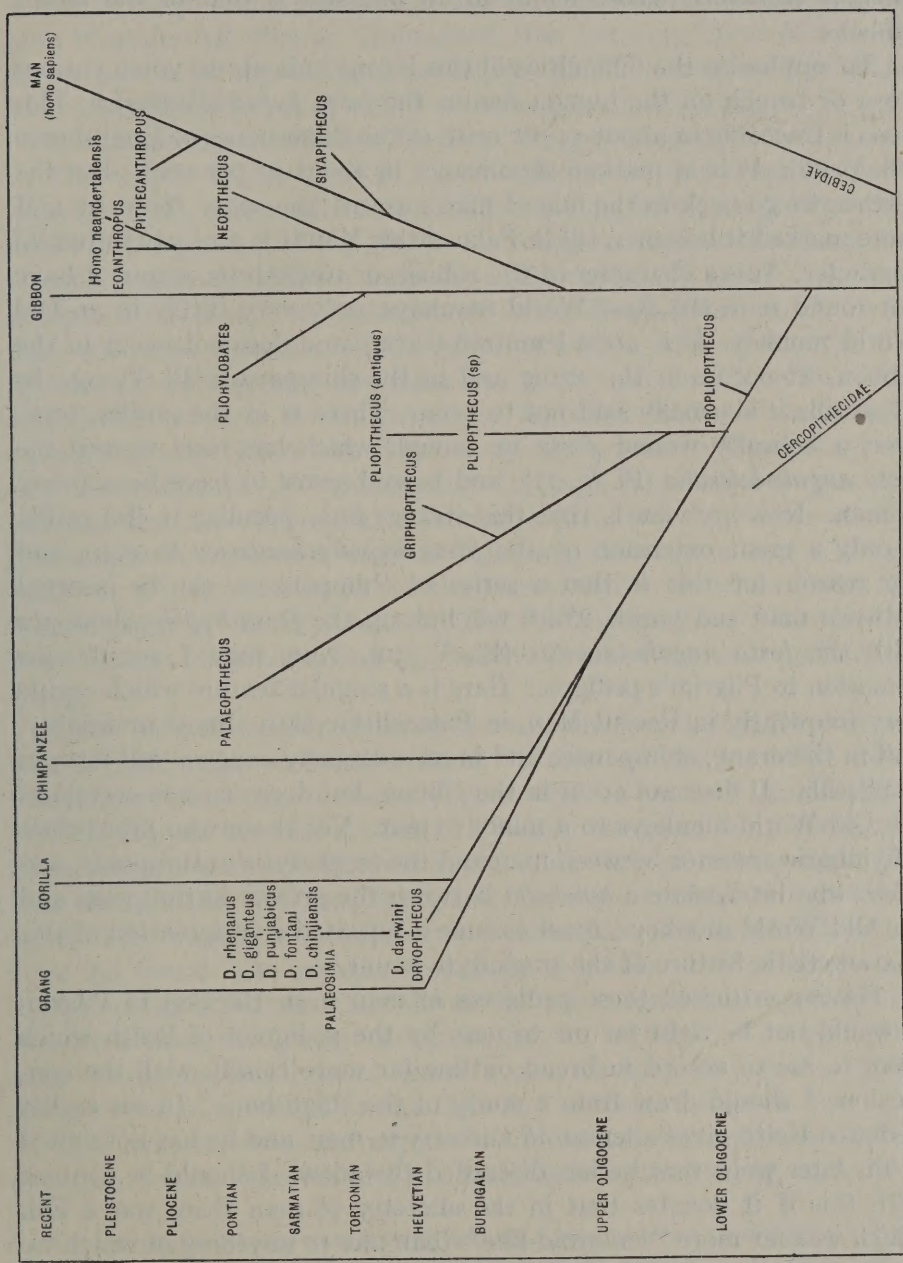
Popliteal convexity is certainly a link with the apes, but its appearance in the Trinil femur—i.e. in a single individual case—is no evidence whatever that we have a non-human form before us. Personally I can scarcely believe that the Trinil femur belonged to the skull-cap.

We may turn now to the feature we have already referred to, namely the "pilaster" of the femur of Recent Man. I doubt very much whether man ever stood really upright until he had developed a pilaster. This is a projecting edge or pillar down the posterior face of the human femur produced by the emphasising and coalescing of the two branches of the *linea aspera*. I find the first faint traces of a pilaster in some of the baboons (Pl. IV, 22), scarcely any whatever in the gibbon (Pl. II, 7 and 8), practically none in the greater anthropoids and little in the Neanderthal type of man (Pl. II, 11). It comes in slightly in the Galley Hill type; it breaks out in a most exaggerated form in Cromagnon (Pl. V, 25 and 26), and in a lesser but quite substantial form has remained the essentially human feature of the thigh-bone today (Pl. IV, 19, 20, VI, 35 right).

It has now become usual to put Neanderthal Man out of the direct line of descent of Recent Man. Sometimes this has also been done with Cromagnon Man. Such a course is especially unreasonable in those who postulate a hylobatic ancestry for man. Somewhere between such a gibbon-like ancestor and Recent Man, first the robusticity of the human femur and secondly its "pilaster" had to be introduced. They come in, it is true, in exaggerated forms with Neanderthal Man and Cromagnon Man, but evolution is rather apt to overstep the mark, to overdo the desired quality and then slowly retrace a bit of its path, to slightly regress to a more stable value of an exaggerated character. If we did not know of the existence of either Neanderthal Man or Cromagnon Man, we should have actually to insert branch points closely corresponding to them in the pedigree of Recent Man before we could consider his descent as adequately described.

Now what does such a pedigree as that of Dubois indicate? Why, that at the branch point of the Old World monkeys there were the first traces of pilaster and massiveness. That these disappeared with *Prothylobates*, that they reappeared in *Pithecanthropus* who also obtained a "pilaster." This was lost in Neanderthal Man, to be recovered again in Cromagnon! I can only say that such a see-saw process makes any real study of evolution impossible.

Much the same criticism applies to one of the most recent of the hylobatic human pedigrees, that of Pilgrim: see p. 11. Here Neanderthal Man and *Pithecanthropus* are placed on branches. Recent Man traces back to a gibbon-like being, which wholly separates him not only from the Old World monkeys with their beginnings of pilaster and more than beginnings of massiveness, but also from the greater anthropoids who



Suggested Evolution of Man and the Anthropoid Apes (Pilgrim).

deduce their origin from another gibbon line, which produced *Dryopithecus rhenanus,* whose femur in all but size is that of the recent gibbons.

To emphasise the difficulties of this let me indicate to you a curious fossa or trough on the human femur, the *fossa hypotrochanterica.* This fossa is traceable in about 34 per cent. of the thigh-bones of Englishmen (Pl. V, 28). It is of marked significance in about 10 per cent. But the further we go back in the line of man's ascent the more frequent and more marked it becomes, till in Palaeolithic Man it is a nearly universal character. It is a character of the robust, or troglodytic femur. I have not found it in the New World monkeys, only very rarely in an Old World monkey. It is not a lemuroid feature and does not occur in the gibbon. It occurs in the orang and in the chimpanzee (Pl. V, 29). In the gorilla it is usually said not to occur. There is in the gorilla, however, a helically wound *fossa* or trough which has been termed the *fossa angulo-lateralis* (Pl. V, 27), and is said never to have been found in man. Now my view is that this strange *fossa* peculiar to the gorilla is only a great extension of the *fossa hypotrochanterica* in man, and my reason for this is that a series of chimpanzees can be inserted between man and gorilla which will link up the *fossa hypotrochanterica* with the *fossa angulo-lateralis* (Pl. V, 30). Now may I recall your attention to Pilgrim's pedigree. Here is a singular feature which occurs very frequently in Recent Man, in Palaeolithic Man almost invariably, and in the orang, chimpanzee and in an extremely exaggerated form in the gorilla. It does not occur in the gibbon, but does occur in certain of the Old World monkeys to a minor extent. Yet those who interpolate a hylobatic ancestor between man and the troglodytic anthropoids, and those who interpolate a *hylobates* between the greater anthropoids and the Old World monkeys, must assume a repeated re-origination of this characteristic feature of the troglodyte femur.

Having criticised these pedigrees of man from Haeckel to Pilgrim it would not be right for me to pass by the pedigrees of Keith which seem to me to accord in broad outline far more closely with the conclusions I should draw from a study of the thigh-bone. In his earlier pedigree Keith gives a lemuroid ancestry to man, and he has not stated in his later work that he has discarded this view. I should be content with this if it denotes that in the ancestry of man there was a link which was far more "lemuroid-like" than like to anything of which we have present cognizance, just as in the ancestry of man there is in my opinion a link which without being a chimpanzee was far more "tro-

glodyte-like" than anything else of which we have cognizance*. Or to extend the principle still further, Recent Man without being descended from Neanderthal Man or Cromagnon Man yet must have had in his ancestry links far more "Neanderthaloid" and "Cromagnon-like" than like to any other forms of which we have present knowledge.

Keith's pedigrees are reproduced on the following page.

The reader will see that in the final form the only thing—beyond what are really minor differences—which one might be tempted to alter would be the position of the gibbon. It seems to me that the sooner we separate finally the gibbons from the anthropoids, and create a distinct group of *Hylobatinae*, the better it will be for English science. If we do this, the main question which arises is, when and where did the *Hylobatinae* spring from the main line of the primates? Keith's long and slender branch throws its origin far back from the immediate ancestry of man. The whole of our study of the primate femur supports this view. But he does interpolate its branch point between the baboons and the anthropoids. We know that the thigh-bone of the gibbon is more massive in its fossil form, but, allowing for that, it is very hard—on a judgment based on the femur alone—to believe that the branch point of the *Hylobatinae* must be interpolated between the branch point of baboons and the branch point of the man-anthropoid group.

I now turn to another anomaly in man, which undoubtedly presents greater difficulties of interpretation. I refer to the so-called third trochanter. It occurs in about 40 per cent. of cases of Recent Man (Pl. VI, 31), but in many of these it is hardly recognisable. It occurs in all lemurs, and in many still lower types of life. It is more frequent in the New than the Old World monkeys, and may even be said to be rare in the latter. I have found it occasionally but *inconspicuously* in the gibbon. I have not found it in orang, chimpanzee or gorilla. I think all we can say about this is that man and the gibbon are in some few respects more primitive than the greater anthropoids. It certainly is curious that man should in this respect show a greater frequency and a more intense form of lemuroid vestige than any of the anthropoids.

It is not, however, an argument of descent through a hylobatic ancestor, because the feature is a more intense survival in man than

* It is desirable to refer to this point, because a recent reviewer in the *Lancet* of the Monograph on the Femur dismisses our discussion on the ancestry of man by stating as an illustration of its fatuity that we trace his descent from the lemuroids, which is described as an hypothesis discarded by all modern biologists.

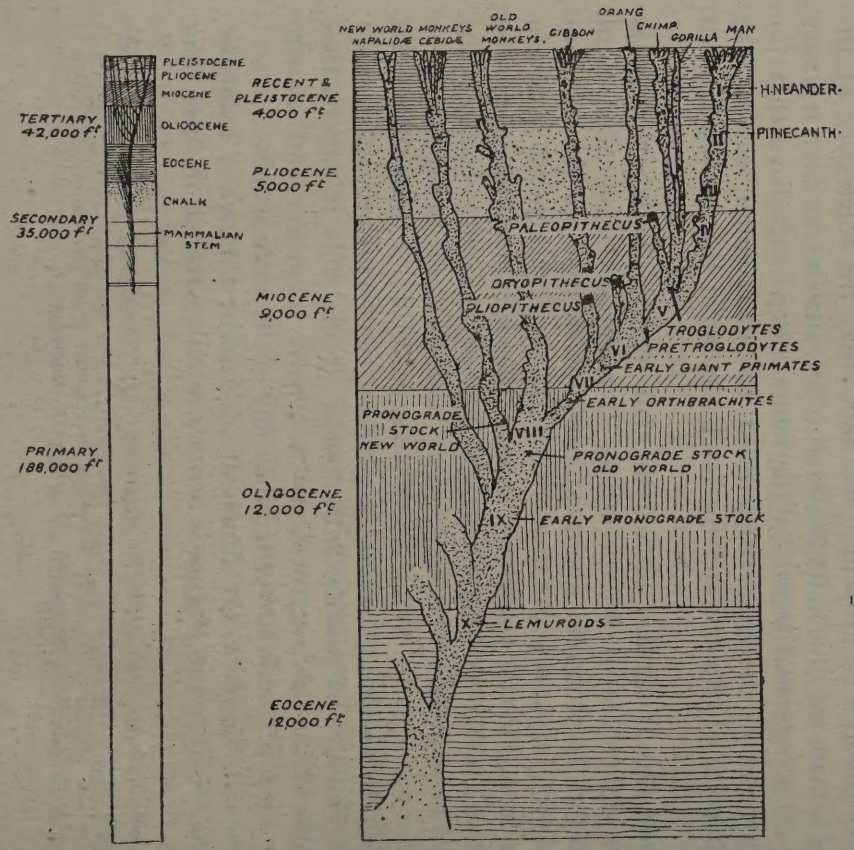


Fig. (i).

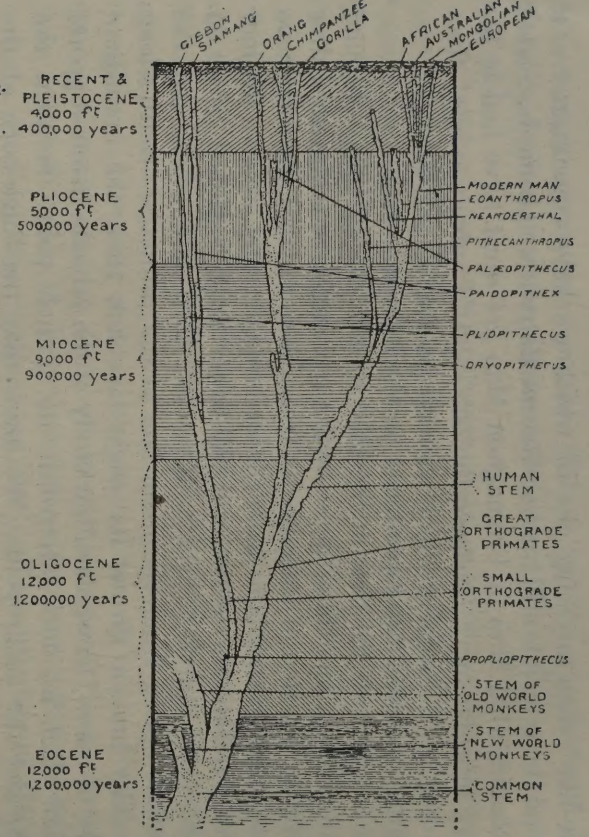


Fig. (ii).

Suggested Evolution of Man and the Anthropoid Apes, according to Keith. Taken by Professor Keith's permission from *Scientia*. Fig. (i) earlier, Fig. (ii) later, more developed scheme.

in the gibbon. I believe that the prot-simio-human would show the third trochanter more markedly than man, just as Palaeolithic Man shows it more intensely than Recent Man. Although in a narrow terminological sense the troglodytic femur, i.e. that of the gorilla or the chimpanzee, bears no third trochanter, I hold the third trochanter in the sense of the present lecture to be a sign of a troglodytic femur, i.e. of a massive, bowed, deeply fossed, rugous femur, one denoting much strength and muscularity—as distinct from the hylobatic femur—which is the femur of an agile, slender, and slightly built ape, for whom specialisation in speed has been a saving characteristic. The spider monkey, *Ateles*, of South America, which has in its femur many points of resemblance to the gibbon, has also retained traces of the third trochanter. It is conceivable that its retention, even if slight, may be associated with swift arboreal flight, and that man retained this faculty longer than the baboons or the greater anthropoids. To suggest this, however, is very far from an acceptance of Bumüller's hypothesis that *Pithecanthropus* was only a gigantic gibbon. The stature of the owner of the Trinil femur must have been about 167 cms., not far from that of the average Englishman one meets in the streets today, and corresponding to a weight of quite possibly 12 stones! He would have had considerable trouble in swinging himself with rapidity from branch to branch, and the Trinil femur is just as unsuited to that form of progression as that of Recent Man with which it is identical.

The third trochanter therefore only teaches us that for which I have tried to prepare you, namely, that in the long bones of the skeleton the prot-simio-human, the common ancestor of man and the anthropoids, had human characters as well marked as ape-like characters.

Thus far I have dealt with descriptive characters of the thigh-bone because they are easier to illustrate on the screen, and are less fatiguing than rows of figures. There are, however, many numerical or measuremental results, a few only of which I can indicate to you tonight, which confirm the view that the gibbon cannot be interpolated in any form as a direct ancestor of man, between the branch point of the baboons and that of Neanderthal Man.

We have seen that the hylobatic femur is a slender, little bowed, upright, parallel faced bone, and that the troglodytic femur is a massive, much bowed, and deeply fossed structure; the one is built for agility, the other for strength.

Let us briefly take the numerical measures of some of these characteristics. The index of bowing is measured by the ratio of

100 times the subtense of the bow to the length of its chord*. We find:

Index of Bowing.

Tarsius	− 1·3		
Lemuroids	− 0·5		
Gibbon: Fossil ...	+ 0·6	+ 0·2	
„ Recent ...	− 0·2		
New World Monkeys		1·9	
Old World Monkeys		3·5	
Orang	+ 1·8	+ 2·7	
Chimpanzee	+ 3·0		
Gorilla	+ 3·4		

Pithecanthropus erectus	2·8
Neanderthal Man (8)	3·7
Galley Hill Woman (1)	2·7
Cromagnon Man (5) ...	4·3
Recent Man (800) ...	2·5

You will see at once how, judged by bowing, the thigh-bone of man, past and present, belongs to the troglodytic—the baboon and the chimpanzee—group of femora, and not to the hylobatic group.

We will next take the measures of the robustness of the femur. The first is the ratio of the sum of the two central diameters of the shaft to the total length of the femur—the *index of robusticity*, and the second is the robusticity of the femoral head or the ratio of the sum of the diameters of the head to the length of the femur.

Indices of Robusticity.

	Robusticity of femur	Robusticity of femoral head
Tarsius	9·9	12·0
Lemuroids	11·5	15·6
New World Monkeys	11·5	16·9
Old World Monkeys	13·2	17·6
Recent Gibbon ...	9·4	16·8
Fossil Gibbon ...	12·3	16·7
Pithecanthropus ...	12·7	19·7
Chimpanzee ...	15·5	22·6
Gorilla	18·5	25·6
Orang-utan... ...	14·9	26·4
Neanderthal Man ...	14·3	25·0
Cromagnon Man ...	13·0	21·8
Recent Man:		
Japanese ...	13·1	22·0
English	12·7	20·6
Australians ...	12·5	18·6

This table reiterates the lesson we have already learnt, namely, *Tarsius* in its proportions is almost at the opposite pole to man. The

* To grasp the nature of bowing the reader should turn to Pl. II, 10, III, 14 and 15, and IV, 20.

Recent Gibbon is less robust than his fossil form, and Palaeolithic Man stands nearest to the greater anthropoids, although Recent Man exhibits less robustness of thigh-bone than his fossil forms.

Another good measure of massiveness is the ratio of the bicondylar width of the thigh-bone to its total length.

Bicondylar Ratio.

Tarsius	10·7	*Pithecanthropus erectus*	17·4
Lemuroids	13·5	Neanderthal Man ...	20·8
New World Monkeys	15·4	Grimaldi Negro Type	19·0
Old World Monkeys	15·3	Cromagnon Man ...	18·4
Fossil Gibbon ...	14·3	Recent Man:	
Recent Gibbon ...	14·1	Japanese	19·2
Chimpanzee	21·6	English	17·5
Orang-utan	22·1	Australians... ...	16·5
Gorilla	23·9		

Again we have the same story. *Tarsius* and the gibbon are quite out of the running if the goal be close relationship to man. The Trinil femur is just Modern Man and we have Palaeolithic Man close to the chimpanzee group, whence man gets less robust in the dimensions of the distal epiphysis down to recent times. You will notice that in all the last three tables, I have illustrated Recent Man by giving the index values for three groups, the Japanese, the English and the Australian. In all these cases it is not the Australian native whose thigh-bone stands closest to that of Palaeolithic Man, as some anthropologists have asserted. It is the thigh-bone of what I term the "fringe" races, the races of men who have been driven to the extremes of the earth, the Japanese, Aino, Laplanders, Eskimo, even the Fuegians of South America and the Moriori (now extinct) of the Chatham Isles; these are short races with massive bones. These are the races where we may most expectantly look for vestiges of man's past history. I should anticipate that if the palaeontologists ever find the fossil remains of a prot-simio-human, it will have somewhat the appearance of a dwarf Neanderthal race with the skull of an infant anthropoid, which is far closer to the skull of infant man than that of the adult troglodyte*. This may suggest to some of you that we ought to look to the dwarf races of the earth for our ancestors—a view recently propounded by a German—to the Akkas, Andamans and Bushmen (Pl. VI, 33 and 34). I cannot accept this view. These dwarf races of men have quite normal thigh-bones,

* The infant anthropoid and infant man are as a rule closer in all skeletal characters than the adult. For example compare the femora in Pl. VI, 32.

simply small models of those of their bigger brothers. Unlike the "fringe" peoples they exhibit in their proportions no closer approach than Recent European Man to Palaeolithic Man.

You will please note that I do not speak of *absolute size*, but of the indices or proportions of the thigh-bone. If you look at illustrations like Pl. VI, 35 and 36, with thigh-bones of orang, Mousterian Man and Recent Man, you will remark that the step from Recent Man as represented by a very primitive femur to Palaeolithic Man is greater than from the latter to the orang. Breeders know that change of size is fairly easy to establish, but that proportions are far harder to fix. Look at the following table which gives the relative heights of great trochanter and of head above the horizontal (cf. Pl. VI, 35 and 36). With the apes, the trochanter is usually as high as the head, but the reverse is true in man. I term the ratio of the two heights above the horizontal plane of the knee joint the Pithecoid Index. The table shows the equality of the heights of trochanter and head in all the apes. *Pithecanthropus* is not hylobatic, but Recent Man-like, and Primogenial Man is closer to the apes than Recent Man. The table, however, does not permit us to throw

Pithecoid Index.

Tarsius	99·6	Chimpanzee ...	100·0
Lemuroids	100·3	Gorilla	100·0
New World Monkeys	98·8	*Pithecanthropus* ...	95·6
Old World Monkeys	101·7	Neanderthal Man ...	96·7
Fossil Gibbon ...	99·2	Cromagnon Man ...	97·1
Recent Gibbon ...	99·3	Recent Man ...	95·3
Orang	92·7		

additional light on our problem, for the early *Hylobates* has practically the same pithecoid index as the greater anthropoids, orang excepted. In this respect the orang has travelled in the same direction as Recent Man—and overshot him—an unusual occurrence.

As a last table we may take that of the Lemotic Index, the proportion of the neck of the thigh-bone to the length. We have:

Lemotic Index.

Tarsius	4·7	Gorilla	15·9
Lemuroids	6·2	*Pithecanthropus* ...	11·4
New World Monkeys	8·6	Neanderthal Man ...	11·1
Old World Monkeys	8·3	Galley Hill Woman	11·3
Gibbon	9·6	Cromagnon Man ...	11·1
Fossil Gibbon ...	10·8	Grimaldi Negro Type	12·6
Chimpanzee ...	14·2	Recent Man ...	12·2
Orang	14·4		

We see from this table that Recent Man is nearer to the Recent Chimpanzee than to the Recent Gibbon, but that Primogenial Man and the Primogenial Gibbon approach closer together, the gibbon lengthening the neck and man shortening the neck of the thigh-bone. Unfortunately we have no fossil forms of the greater anthropoids. They also,

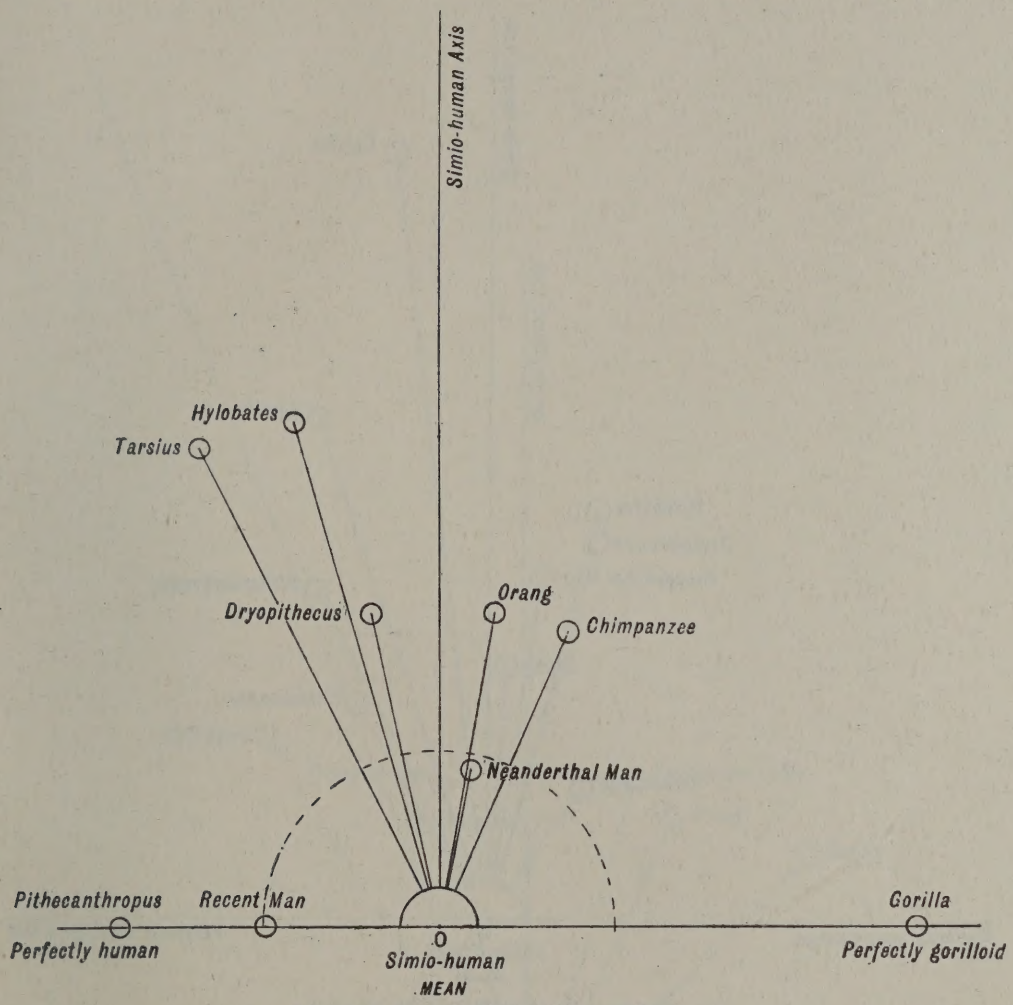


Diagram A. (General Indices of Femur.)

I am convinced, would have shorter necks and I should fix the prot-simio-human lemotic index at about 10·5.

It would, however, be impossible to carry you through all the tables for the forty indices or ratios of the thigh-bone of the primate that Dr Bell and I have provided. All I can now do is to show you a more

or less complete graphical summary of the results. In doing this I have proceeded in the following way. I have found the mean index for the primate group which includes man and the anthropoids—fossil and recent. I term this the simio-human mean. I then take the sum of the mean deviations from this mean of any species as representing its

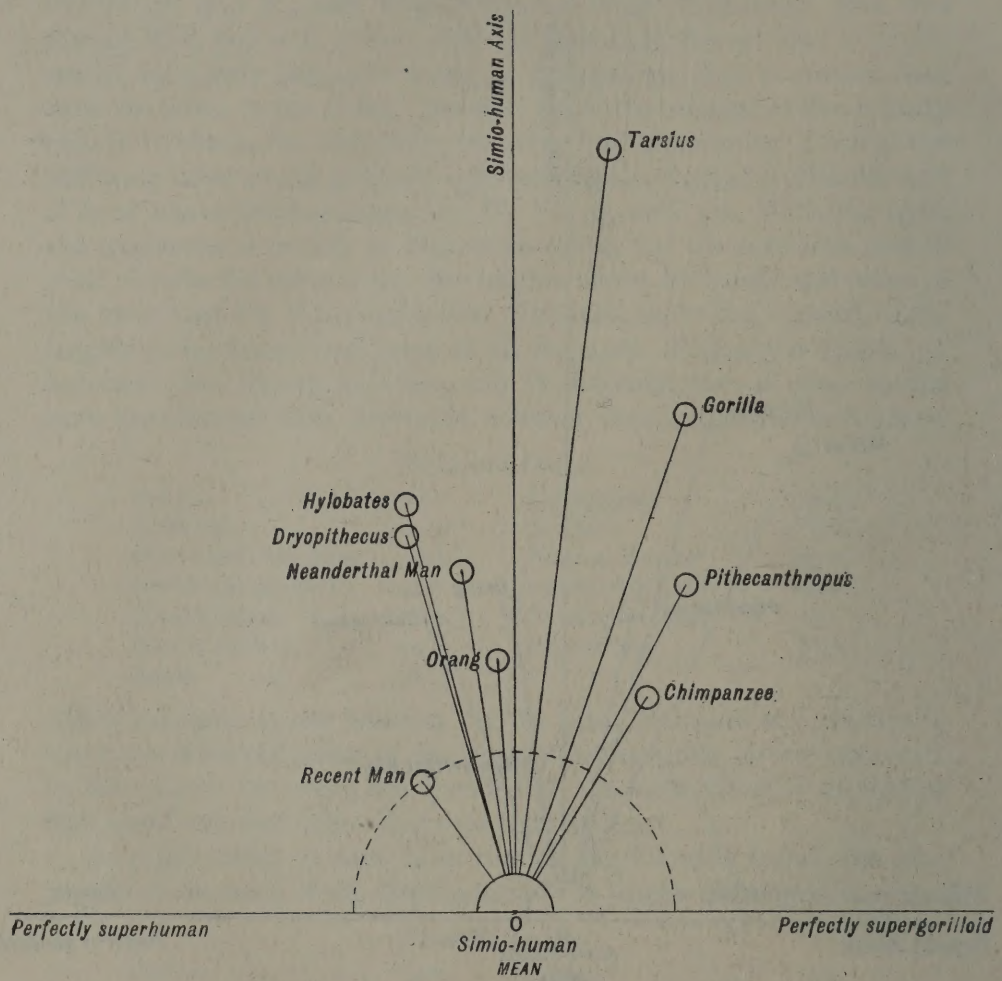


Diagram B. (Indices of the Shaft.)

divergence from a common ancestral form. But I give it an angular sign according as the excess is towards the gorilloid or the human side of the simio-human mean. I illustrate this first on the general indices of the thigh-bone, such as the index of robusticity, the pithecoid index, etc., to which I have already referred: see Diagram A, p. 19.

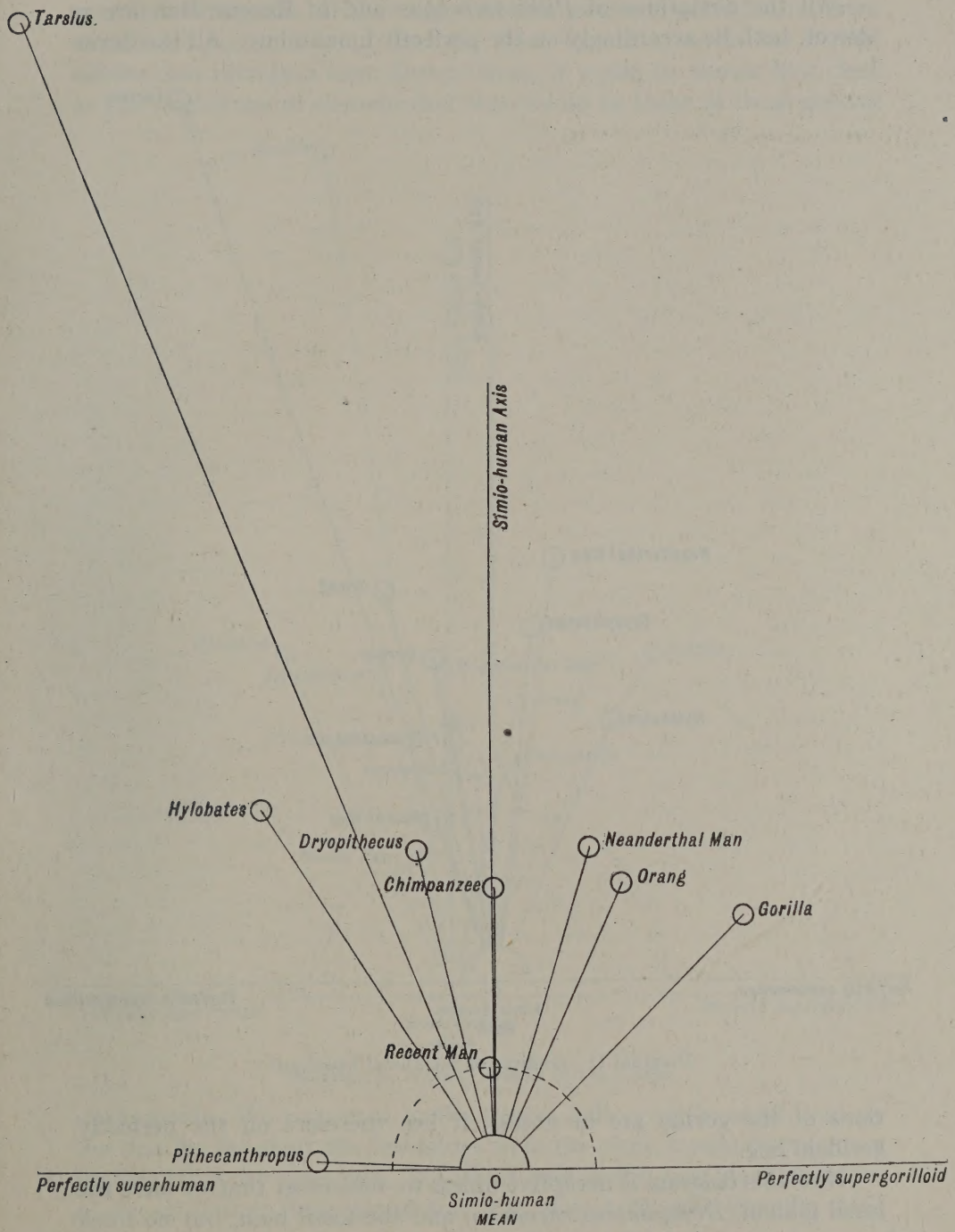


Diagram C. (Indices of the Proximal Epiphysis.)

All the deviations of *Pithecanthropus* and of Recent Man are in defect, both lie accordingly on the perfectly human line. All the devia-

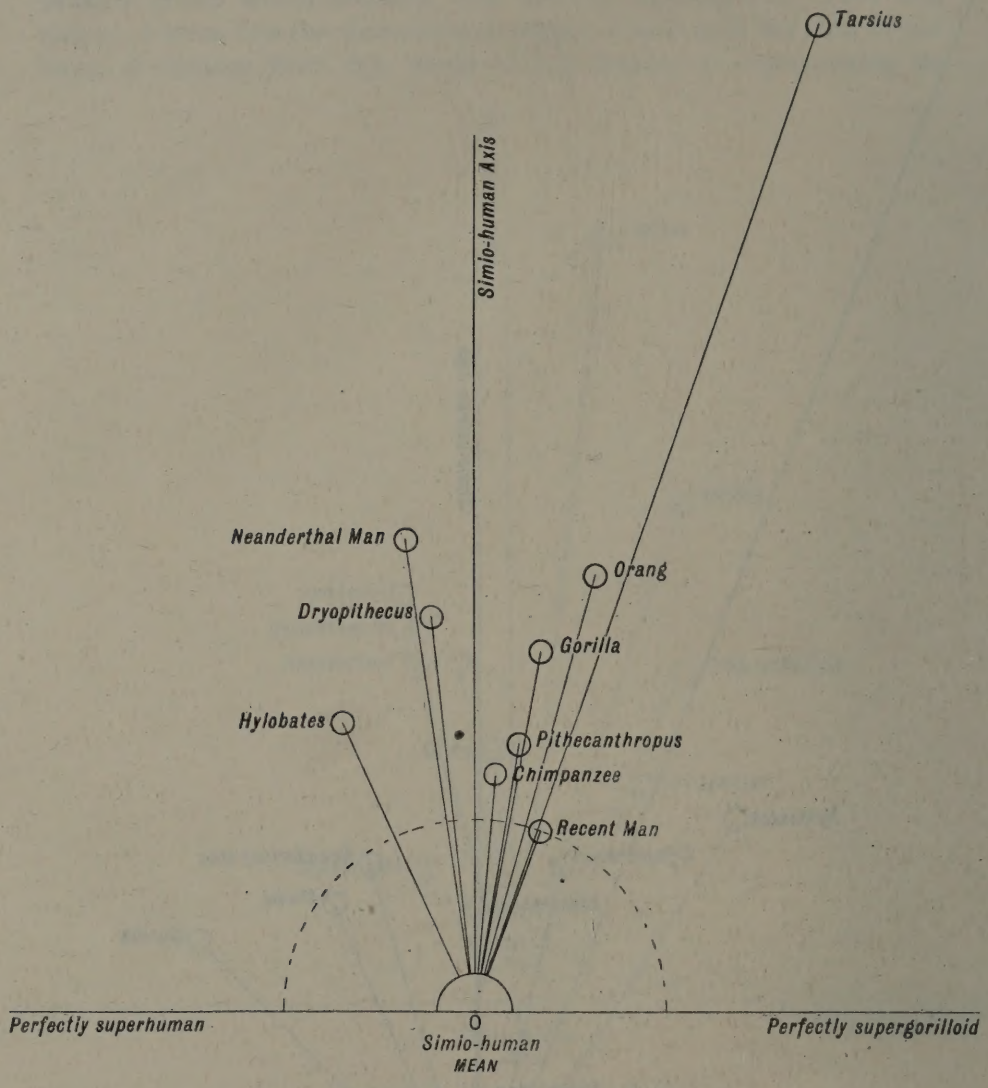


Diagram D. (Indices of the Distal Epiphysis.)

tions of the gorilla are in excess, it lies therefore on the perfectly gorilloid line.

Now this diagram is deceptive unless we remember that we have the fossil gibbon, *Dryopithecus rhenanus*, and the fossil man, but no fossil

greater anthropoids. If the orang and chimpanzee retreated as far from their fossil positions away from the simio-human mean as the Recent Gibbon has retreated from *Dryopithecus*, it would be clearer how close to the thigh-bone of Neanderthal Man would be those of these greater

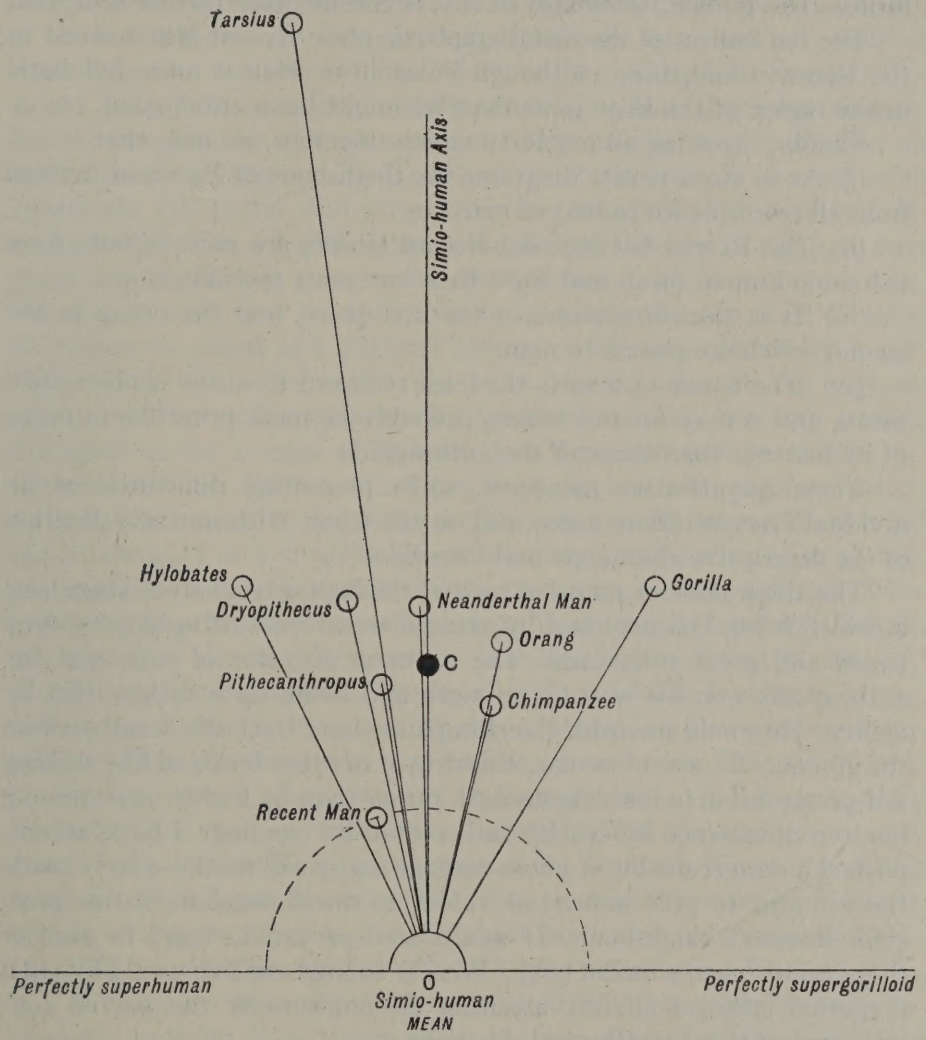


Diagram E. (Total Indices of the Femur.)

anthropoids. We turn next to the twelve indices of the shaft, and we see that for the shaft the deviations from the simio-human mean are in no case all of the same sign. We see at once that it is in the dimensions of the shaft that Primogenial Man was most hylobatic, that the shaft

of the femur of Recent Man is nearest to those of orang and chimpanzee, and would be doubtless still nearer to their fossil forms.

Passing to the twelve indices of head and neck, it is the chimpanzee and orang which come nearest to man both in his recent and palaeolithic forms. The gibbon, fossil and recent, is considerably further removed.

The ten indices of the distal epiphysis place Recent Man nearest to the Recent Chimpanzee, although Palaeolithic Man is more hylobatic in the region of the knee joint than we might have anticipated.

Finally, throwing all our forty indices together, we note that:

(i) As in our separate diagrams the thigh-bone of *Tarsius* is remote from all resemblance to that of man.

(ii) The Recent Gibbon and Recent Gorilla are most remote from the simio-human mean and show therefore most specialisation.

(iii) It is the chimpanzee in the first place, and the orang in the second which are closest to man.

(iv) The femur of man is the least removed from the simio-human mean, and it may for this reason probably be more primitive in many of its features than those of the anthropoids.

These quantitative measures, while presenting difficulties of individual interpretation, agree well on the whole with our investigation of the descriptive characters and "vestiges."

The thigh-bone of man has passed through a troglodyte stage, one in which it was characterised by extreme massiveness of epiphyses, deep fossae and great robustness. The common ancestor of man and the anthropoids won his way by strength and brute force rather than by agility. He would resemble the chimpanzee and the baboon rather than the gibbon. He was muscular, a destroyer of other forms of life, seeking self-preservation in his own strength rather than by flight—maintaining his own dominance by cruelty rather than by cunning. I have accomplished a dangerous bit of guess-work as many will think—I have made the attempt to give numerical values to the dimensions of this prot-simio-human's thigh-bone. It would need an artist's hand to transfer those numbers to a model bone. Were it carried out one would live in a perpetual state of anxiety awaiting discomfiture or the partial confirmation of this hypothetical creation!

But a study of the thigh-bone of the primates has convinced me that the ancestry of man must be traced through troglodyte rather than hylobatic lines. We may be ashamed of the ravening and ferocious character of our forefathers. But whether we approve their methods or not, their natures gave us finally dominance over other living forms,

as craft came to supplement strength. It is idle to regret our ancestry; it is futile to skip all the void to *Tarsius*, because we find it a stain on British science that it should have talked of an ape-like ancestor; the thigh-bone of *Tarsius* never became the thigh-bone of man without stages perilously near the thigh-bone of the baboon and the thigh-bone of the chimpanzee. All we can recognise is that we, nowadays, believe more man-like features will be found in the prot-simio-human than would have been admitted thirty years ago. But if science cannot flatter man and say that the nearest living primate representative of our ancestry is the quaint and fugitive *Tarsius*, may we not still appreciate the lesson that arises from the assertion of a more violent ancestry? Does it not cast light on much of the history of the past five years and of what is going on at the present day? It is not to hear less of evolution that we need, but to understand more of it, to turn its lessons to social and political account. We may ultimately breed out violence from the world, but until this is achieved the highest culture will not suffice to keep the ape-like in check. We may preach the spirit of the League of Nations, but the result will be wholly ineffectual without the force that can hold our ancestral passions under control. That seems to me the practical moral which we can draw from the attribution of a troglodytic rather than a hylobatic femur to the prot-simio-human! But after all it is the artist, not the scientist, who impresses us with the truth which is to bear fruit in conduct. Before I had studied the thigh-bone of the primates, I feared that M. Mascré, the distinguished sculptor of Brussels, might indeed be leading us astray when, under the directions of Professor Rutot, he reconstructed our ancestry from the fragments that remain. Now I have little doubt that his inspirations are approximately on the right lines. If I disagree with his Galley Hill type, for I think the Galley Hill Man was really a woman, and if I puzzle over his reconstruction of the Grimaldi Negro type as an adult man in full activity, when the adult cranium discussed by Verneau is that of a very old woman, I still think his scheme of *Pithecanthropus* (Pl. VII, 37), Heidelberg Man (Pl. VII, 38), Neanderthal Man (Pl. VII, 40), Cromagnon Man (Pl. VII, 42), Neolithic Man, gives us food for thought, and for hope—even after the experience of these last few years. It is not idle dreams of an innocuous past history, but a realisation of the true bearing of the shadow past history casts over the present, that can help us to better the future.

Time was when man was wholly marauder, and his hands were red with blood; time is when man is half bruiser and half sage. Time may

come when he shall be wholly and truly *Homo sapiens*, but that will not be until the red-handed brawler, the troglodyte, has been at least as thoroughly bred out from man as *Canis lupus* has been from *Canis familiaris*.

DESCRIPTION OF PLATES

PLATE I. Fig. 1. *Tarsius spectrum*, being a drawing from an illustration in the *Royal Natural History*, by permission of Messrs Warne and Co. Fig. 2. Peruvian femur after Rodriguez showing lateral protrusion, fossa of the anterior face and crural trough. Fig. 3. Fuegian femur from a cast sent by Professors Martin and Schaffhausen, showing lateral protrusion. Fig. 4. Recent human femora showing various degrees of lateral protrusion. Fig. 5. From left, femora of lion, man, two lemurs and kangaroo showing "frontal pilaster" and lateral protrusion. Fig. 6. Recent Man, Man of Spy, Gorilla; note lateral protrusion of Spy femur and its great robustness.

PLATE II. Fig. 7. Anterior and posterior views of femur of the gibbon, *Hylobates variegatus*. Fig. 8. Anterior and posterior views of the femora of the fossil gibbon, *Dryopithecus rhenanus* (in the centre), and of young (left) and old (right) modern gibbon, *Hylobates mülleri*. Fig. 9. Three aspects of the Trinil femur (discovered by Dubois)—*Pithecanthropus erectus*. The remarkable subtrochanteric exostosis must be disregarded in estimating the character of the femur: it is purely pathological. Fig. 10. Mesial aspects from left to right in order of (i) modern femur, (ii) femur of Man of Spy, (iii) femur of Neanderthal Man, (iv) femur of gorilla. Note the massive heads, condyles and bowing of (ii) to (iv). Fig. 11. Femora of Gorilla, Neanderthal Man, Man of Spy, and Modern Man in posterior aspect from left to right. Note comparative absence of pilaster in first three and subtrochanteric lateral protrusion in the femora of Palaeolithic Man. Fig. 12. The same four femora in anterior aspect.

PLATE III. Fig. 13. Mesial aspect of modern human femur, femur of Man of Spy and Gorilla from left to right. To emphasise bowing of Spy femur and the massiveness of the diaphyses of the two latter. Fig. 14. Modern human femur and tibia in centre; Spy femur and tibia on left; Spy femur double size on right. (After Fraipoint and Lohest.) Fig. 15. Cast of the femur of *Homo mousteriensis* (*Hauseri*) in anterior, mesial and posterior aspects. Note the bowing and massive diaphyses. Fig. 16. Above, modern human femur, popliteal section of concave type. Below, modern human femur, popliteal section of convex type as in Dubois' Trinil femur. Fig. 17. Above, popliteal sections of thigh-bones of adult anthropoids, all convex. Below, popliteal sections of palaeolithic man, Spy to Cromagnon, showing change from convex to concave forms. Fig. 18. Above, popliteal sections of femora of infant anthropoids, also of the fossil gibbon, *Dryopithecus rhenanus*. Below, change from Mousterian Man, through Galley Hill type, to Recent Man.

PLATE IV. Fig. 19. Posterior and lateral views of pathological femora showing marked bowing and pilastric development. Fig. 20. Achondroplasic and rachilic femora (left and right) illustrating marked bowing and pilastric development. Fig. 21. Marked bowing and pilastric development in two femora on left; lateral protrusion of femur on right with frontal pilaster. Fig. 22. Beginnings of pilaster in Old World monkeys; two baboons on left and two macaques on right. Fig. 23. Posterior and anterior views of Galley Hill femur (left) and recent human femur (right). Note great

massiveness of broken head and condyles of former. Fig. 24. Femora (from left) of Recent Man, Man of Tilbury, Cromagnon Man, and Gorilla. Note the sub-trochanteric lateral protrusion in the Tilbury and Cromagnon femora.

PLATE V. Fig. 25. Posterior views (from left) of femora of Recent Man, Tilbury Man, Cromagnon Man and Gorilla. Note the exaggerated pilaster in Tilbury and Cromagnon; the absence in the Gorilla as in Neanderthal Man, and the moderated value in Recent Man. Fig. 26. Mesial view (from left) of Recent Man (L), Tilbury Man, Recent Man (R), Cromagnon Man and Gorilla. Note the extreme bowing and exaggerated pilaster in Tilbury and Cromagnon Men. Fig. 27. Comparison of femora of Gorilla (left) and Recent Man (right) in three aspects, posterior, anterior and lateral. Note the helical fossa (*fossa angulo-lateralis*) of the Gorilla in the last aspect. Fig. 28. Four femora of Recent Man showing the *fossa hypotrochanterica*. Fig. 29. Comparison of femora of Orang and Chimpanzee (left and right) in mesial and lateral aspects. Note the *fossa hypotrochanterica* in the latter aspect. Fig. 30. First four femora from left give illustrations of the *fossa hypotrochanterica* in Recent Man; the next three femora are Chimpanzees showing the transition of this fossa to the helical form peculiar to the Gorilla and illustrated in the last two femora on right, i.e. the *fossa angulo-lateralis* in Gorilla is an exaggerated form of *fossa hypotrochanterica* in Man and Chimpanzee.

PLATE VI. Fig 31. Illustrations of the third trochanter in femora of Recent Man. Fig. 32. Comparison of femora of Infant Man (middle), Orang (left), and Chimpanzee (right) to show the greater resemblance of man and the anthropoids in infancy. Fig. 33. Anterior view from left of Andaman and two Bushmen. Fig. 34. Posterior view from left of two Bushmen and Andaman. Figs. 34 and 35 illustrate that the bones of racial dwarfs do not show greater signs of man's evolutionary development than the bones of non-dwarf Recent Man, the femora of dwarf races are those of non-dwarf races—only reduced in size. Figs. 35 and 36. Femora of Mousterian Man (centre), Orang (left), and of Recent Man (right), of a primitive type, to indicate that absolute size change between Recent Man and Mousterian Man is of the same order as that of Mousterian Man and the anthropoids. The centre femur is Klaatsch's reconstruction from fragments of *Homo mousteriensis* (*Hauseri*).

PLATE VII. Figs. 37, 38, 40–42 from photographs of M. Mascré's busts, by permission of the Proprietors of the *Illustrated London News*. Fig. 39 from a drawing after the reconstruction of the La Quina Man by Dr Henri Martin: see the *Bulletin de la Société préhistorique française*, Séance 27 Fév. 1913. Fig. 37. *Pithecanthropus erectus* (Dubois). Fig. 38. Heidelberg Man. Fig. 39. La Quina Man. Fig. 40. Neanderthal Man. Fig. 41. Man of Combe Capelle. Fig. 42. Cromagnon Man. Many of the details of these reproductions have disappeared owing to the need of reducing them to a size compatible with their issue in a lecture of the present type. The actual lantern slides of the lecture as delivered indicated of course more clearly the detail, upon which much of the argument depends. The reader for whom the subject has special interest should consult the original plates in the two atlases of the Monograph on the Femur by Pearson and Bell, published by the Cambridge University Press.

CAMBRIDGE: PRINTED BY
J. B. PEACE, M.A.,
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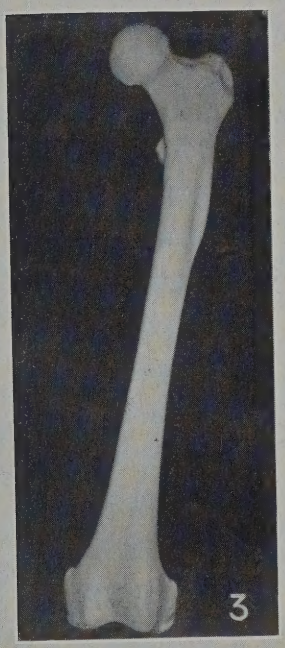
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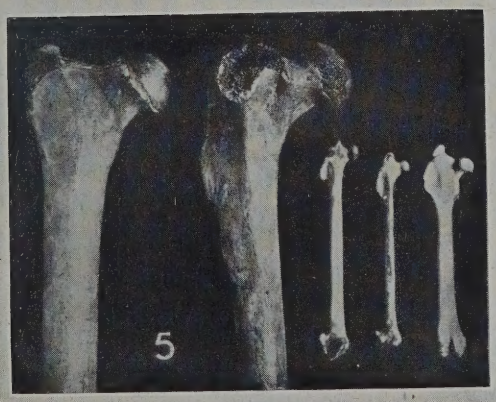
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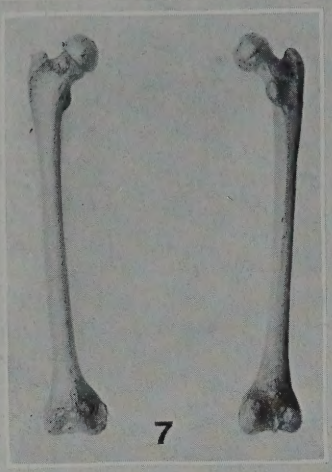
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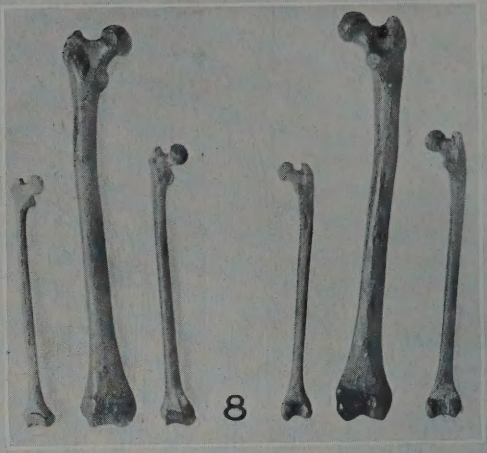
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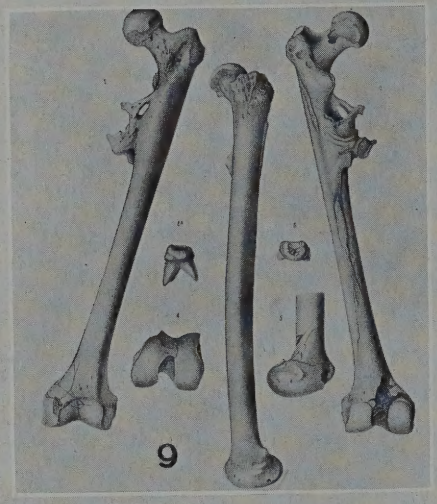
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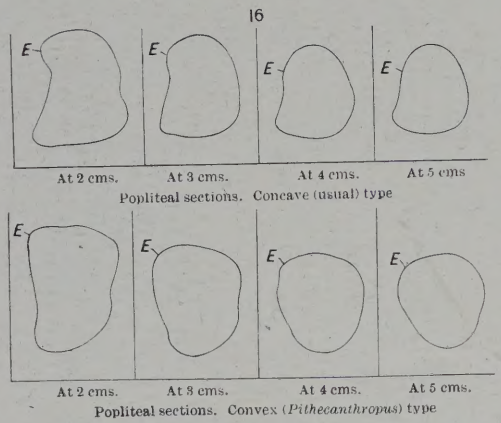
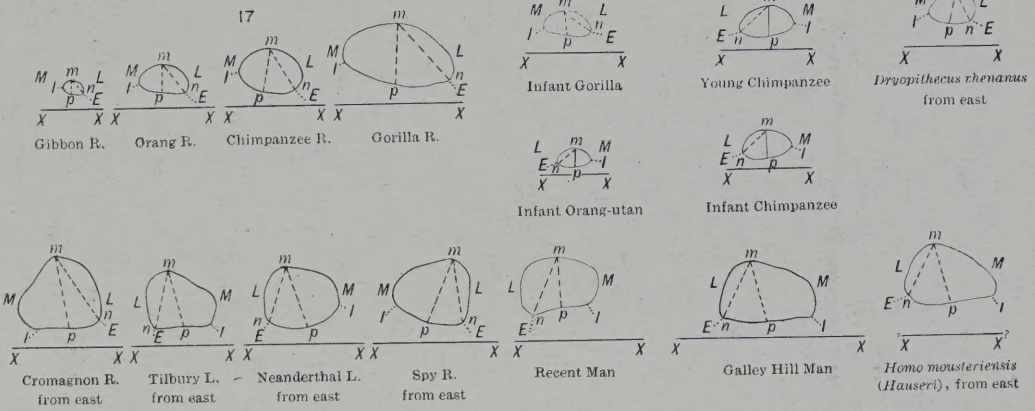
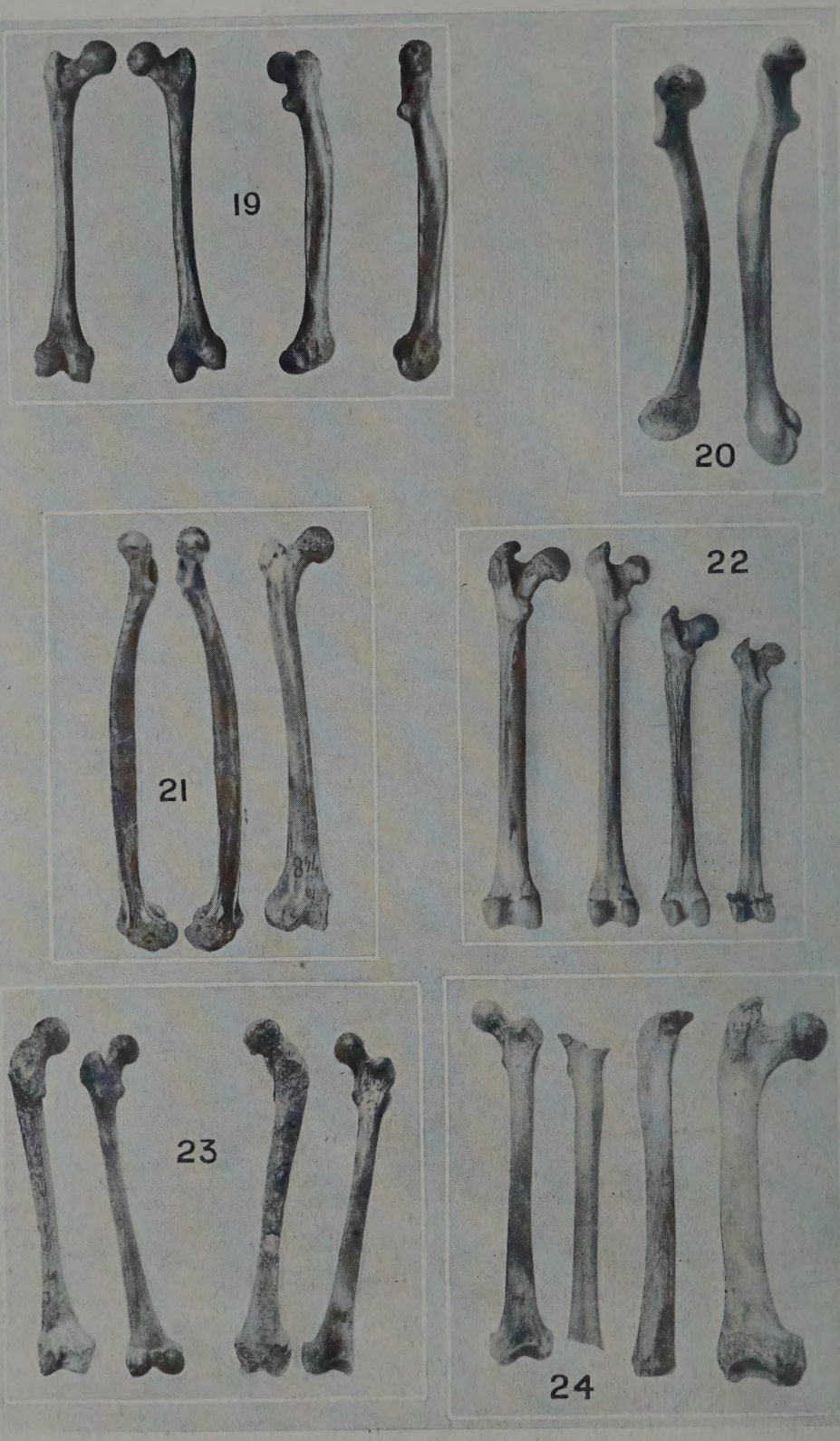




16 About $\frac{1}{3}$ Natural size. *E* is the external supra-condylar ridge. The vertical is the trace of the standard vertical plane on the plane of section, which is taken parallel to the standard horizontal plane.

17 and 18 About $\frac{1}{4}$ Natural size. *E* and *I* are the external and internal supra-condylar ridges as closely as they can be determined. *XX* = Trace of standard vertical plane on plane of popliteal sections ($\frac{1}{15}$ diaphysial length from patellar articular border).

PLATE III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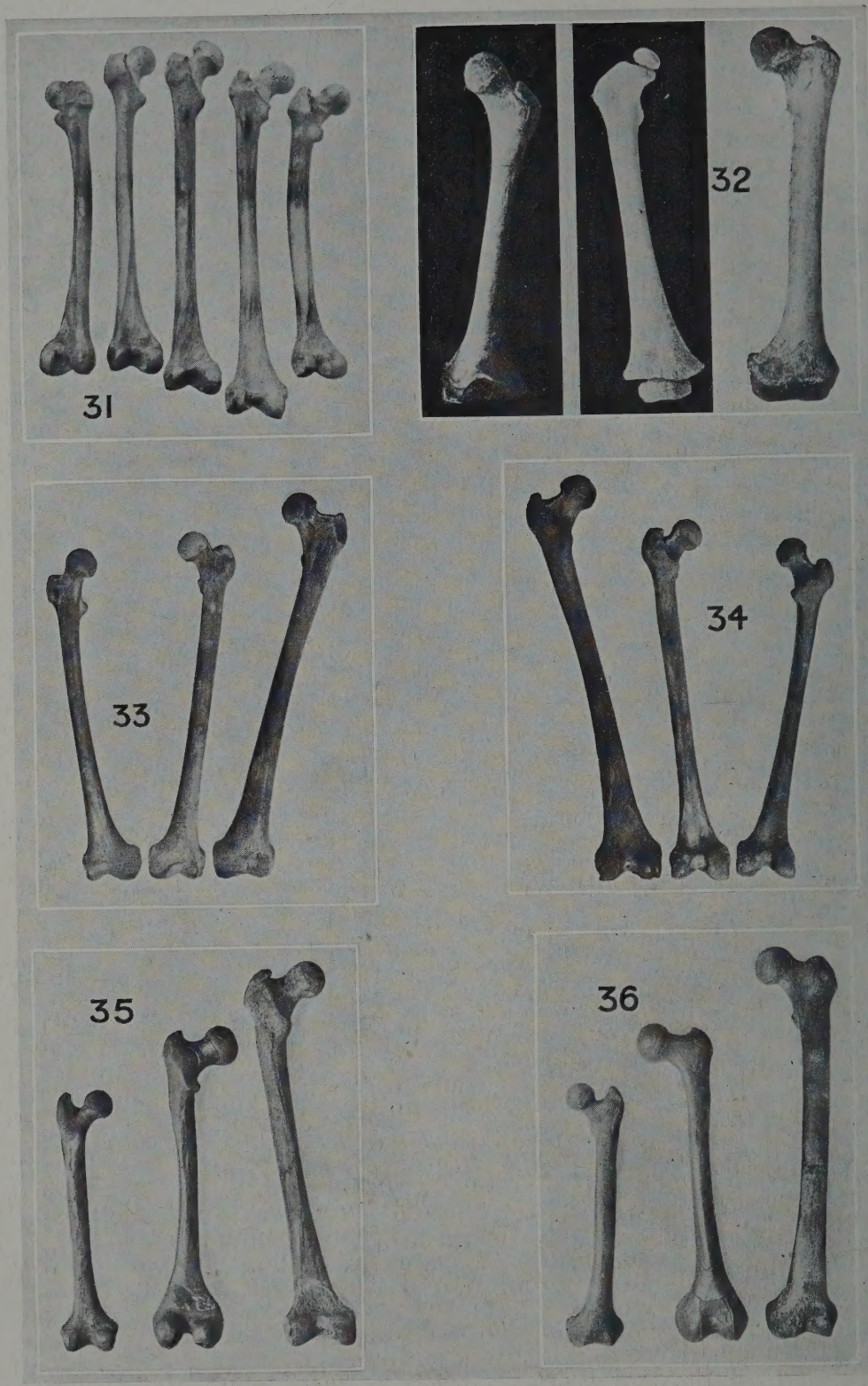
31
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33
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35
36

37 Pithecanthropus erectus
40 Neanderthal Man

38 Heidelberg Man
41 Combe Capelle Man

39 La Quina Man
42 Cromagnon Man

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